Docket No.: M4065.0515/P515-A
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Mark E. Tuttle

Application No.: 10/759,078

Filed: January 20, 2004

For: A METHOD OF FORMING A MAGNETIC TUNNEL JUNCTION (AS AMENDED)

Allowed: February 2, 2007

Confirmation No.: 7172

Art Unit: 3729

Examiner: Anthony D. Tugbang

REQUEST TO CORRECT NOTICE OF ALLOWANCE AND FEE(S) DUE

MS Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In reviewing the above-identified application file upon allowance, Applicants have noticed that the title has not been amended as requested in the Amendment dated October 19, 2006. Enclosed are copies of papers as filed.

The correct title of the invention should read:

A METHOD OF FORMING A MAGNETIC TUNNEL JUNCTION

The undersigned has also noticed that the correspondence address as reflected on the Notice of Allowance and Fee(s) Due is incorrect.

The correct correspondence address should read:

DICKSTEIN SHAPIRO LLP
1825 EYE STREET
WASHINGTON, DC 20006-5403

The PTO is therefore kindly requested to issue a corrected Notice of Allowance as soon as possible.

Applicants additionally request that all pertinent U.S. Patent and Trademark Office records relating to the subject application be changed to reflect the correction and that a corrected Notice of Allowance and Issue Fee Due transmittal be issued for use when paying the issue fee.

Dated: March 5, 2007

Respectfully submitted,

By _____
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Atty Docket No.: M4065.0515/P515-A

Inventor: Mark E. Tuttle

Application No.: 10/759,078-Conf. #7172 **Filing Date:** January 20, 2004
Title: CONTROL OF MTJ TUNNEL AREA

Documents Filed:

Amendment in Response to Non-Final Office Action (pages)

Amendment Transmittal (1 page)

Drawing (1 replacement)

Via: USPTO Daily Run
Sender's Initials: TJD/AMB/sg **Date:** October 19, 2006

Docket No.: M4065.0515/P515-A
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Mark E. Tuttle

Application No.: 10/759,078 Confirmation No.: 7172

Filed: January 20, 2004 Art Unit: 2825

For: CONTROL OF MTJ TUNNEL AREA Examiner: V. Siek

AMENDMENT IN RESPONSE TO NON-FINAL OFFICE ACTION

MS Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

INTRODUCTORY COMMENTS

In response to the Office Action dated July 28, 2006, please amend the above-identified U.S. patent application as follows:

Amendments to the Specification begin on page 2 of this paper.

Amendments to the Drawings begin on page 3 of this paper.

Amendments to the Claims are reflected in the listing of claims which begins on page 4 of this paper.

Remarks/Arguments begin on page 9 of this paper.

AMENDMENTS TO THE SPECIFICATION

Please amend the title to read: "A Method of Forming a Magnetic Tunnel Junction."

On page 2, please amend the paragraph before "Field of the Invention" to read:

"This application is a divisional of U.S. Application Serial No. 10/120,512, filed on April 12, 2002, now U.S. Patent No. 6,903,396, which is hereby incorporated by reference in its entirety."

AMENDMENTS TO THE CLAIMS

Claims 1-56. (Canceled)

57. (Currently amended) A method of forming a magnetic tunnel junction, said method comprising the steps of:

forming a first magnetic layer;

forming a first nonmagnetic layer in contact with said first magnetic layer;

removing a portion of said first nonmagnetic layer to form an opening which exposes a portion of said first magnetic layer; ~~and~~

forming a tunnel barrier layer within said opening in contact with said first magnetic layer; and

forming a second magnetic layer over and in contact with said tunnel barrier layer.

58. (Original) The method of claim 57 wherein said first nonmagnetic layer is formed to be thicker than said tunnel barrier layer.

59. (Original) The method of claim 58 wherein one of said first and second magnetic layers is a free layer.

60. (Original) The method of claim 59 wherein the other of said first and second magnetic layers is a pinned layer.

61. (Original) The method of claim 60 wherein said tunnel barrier layer is formed to have a smaller surface area than said free layer.

62. (Original) The method of claim 57 wherein said first nonmagnetic layer comprises aluminum oxide.

63. (Original) The method of claim 57 wherein said tunnel barrier layer comprises aluminum oxide.

64. (Original) The method of claim 58 wherein said first nonmagnetic layer is formed to have a thickness in a range of about 20 Angstroms to about 300 Angstroms.

65. (Original) The method of claim 64 wherein said tunnel barrier layer is formed to have a thickness in a range of about 5 Angstroms to about 20 Angstroms.

66. (Original) The method of claim 60 wherein edges of said free layer are formed over at least said first nonmagnetic layer.

67. (Canceled)

68. (Original) The method of claim 60 wherein said tunnel barrier layer is centered with respect to said free layer.

69. (Original) The method of claim 60 wherein said tunnel barrier layer is positioned off-center with respect to said free layer.

70. (Original) The method of claim 60 wherein said tunnel barrier layer is formed to have a different shape than said free layer.

71. (Original) The method of claim 60 wherein said tunnel barrier layer and said free layer are formed to have substantially the same shape.

72. (Original) The method of claim 60 further wherein said tunnel barrier layer is formed to extend outside of said opening.

73. (Withdrawn) A method of forming a magnetic random access memory element, said method comprising:

forming a substrate;

forming at least one first conductive line;

forming at least one first ferromagnetic layer in electrical communication with said at least one first conductive line;

forming at least one first nonmagnetic layer over said at least one first ferromagnetic layer;

forming at least one opening in said at least one first nonmagnetic layer;

forming a tunnel barrier layer within said opening;

forming at least one second ferromagnetic layer over said tunnel barrier layer; and

forming at least one second conductive line in electrical communication with said at least one second ferromagnetic layer.

74. (Withdrawn) The method of claim 73 where one of said at least one first and said at least one second ferromagnetic layers is a free ferromagnetic layer.

75. (Withdrawn) The method of claim 74 wherein the other of said at least one first and said at least one second ferromagnetic layers is a pinned ferromagnetic layer.

76. (Withdrawn) The method of claim 73 wherein said at least one first nonmagnetic layer is thicker than said tunnel barrier layer.

77. (Withdrawn) The method of claim 75 wherein and said tunnel barrier layer is formed to have a smaller surface area than said free ferromagnetic layer.

78. (Withdrawn) The method of claim 73 wherein said at least one first nonmagnetic layer comprises aluminum oxide.

79. (Withdrawn) The method of claim 73 wherein said tunnel barrier layer comprises aluminum oxide.

Claims 80-91. (Canceled)

92. (Withdrawn) A method of forming a magnetic tunnel junction, said method comprising the steps of:

forming a pinning structure comprising a pinned layer;

forming a first nonmagnetic layer in contact with said pinning structure;

removing a portion of said first nonmagnetic layer to form an opening which exposes a portion of said pinning structure; and

forming a tunnel barrier layer within said opening in contact with said pinning structure; and

forming a sensing structure comprising a free layer over said tunnel barrier layer.

93. (Withdrawn) The method of claim 92 wherein said pinning structure is formed to be thicker than said tunnel barrier layer.

94. (Withdrawn) The method of claim 92 wherein said step of forming said pinning structure further comprises forming a seed layer.

95. (Withdrawn) The method of claim 94 wherein said seed layer comprises nickel-iron.

96. (Withdrawn) The method of claim 92 wherein said step of forming said pinning structure further comprises forming an anti-ferromagnetic layer.

97. (Withdrawn) The method of claim 96 wherein said antiferromagnetic layer comprises manganese-iron.

98. (Withdrawn) The method of claim 92 wherein said tunnel barrier layer is formed to have a smaller surface area than said sensing structure.

99. (Withdrawn) The method of claim 92 wherein said pinned ferromagnetic layer comprises nickel-iron.

100. (Withdrawn) The method of claim 92 wherein said step of forming said sensing structure further comprises forming a cap layer.

101. (Withdrawn) The method of claim 100 wherein said cap layer comprises tantalum.

102. (Withdrawn) The method of claim 92 wherein said free ferromagnetic layer comprises nickel-iron.

AMENDMENTS TO THE DRAWINGS

New Figure 1 is being added including a legend identifying the drawing as "Prior Art." No new matter is being added.

JP'192 discloses forming a first tunnel barrier layer 310 above and in contact with a first magnetic layer 210, depositing ferromagnetic particles 110 on top of the first tunnel barrier layer 310, forming a second tunnel barrier layer 311 over the ferromagnetic particles 110, and forming a second magnetic layer 211 above and in contact with the second tunnel barrier layer 311. Particularly, the second magnetic layer 211 is not formed over and in contact with a tunnel barrier layer that is in turn formed over and in contact with the first magnetic layer 210. In other words, in JP'192 the second magnetic layer 211 is not formed in contact with the first tunnel barrier layer 310. JP'192 therefore fails to disclose a fabrication method which includes the steps of "forming a tunnel barrier layer within said opening in contact with said first magnetic layer; and forming a second magnetic layer over and in contact with said tunnel barrier layer." Dunkleberger and Lehrer are both unrelated to magnetic tunnel junction technology and were both cited for the purpose of showing conventional techniques of removal of a portion of a layer. Neither reference cures the noted deficiency of JP'192. Accordingly, withdrawal of the rejection is respectfully requested.

Claims 59-61, 63-69, and 71-72 stand rejected under 35 U.S.C. §103(a) as being unpatentable over the combination of JP'192, Lehrer, and Dunkleberger in further view of U.S. Patent No. 6,181,537 to Gill. The rejection is respectfully traversed.

Claims 59-61, 63-69, and 71-72 depend from claim 57 and contain the limitations of claim 57 stated above. Gill is cited in the Office Action for the purposes of showing a tunnel junction layer having a magnetic layer that is a pinned layer, and for showing the comparative thickness of the tunnel barrier layer and the free (second magnetic) layer. Gill does not disclose "forming a tunnel barrier layer within said opening in contact with said first magnetic layer; and forming a second magnetic layer over and in contact with said tunnel barrier layer" and therefore does not cure the

barrier layer within said opening in contact with said first magnetic layer; and forming a second magnetic layer over and in contact with said tunnel barrier layer" and therefore does not cure the deficiencies of JP'192 described above. Accordingly withdrawal of the rejection is respectfully requested.

In view of the above amendment, applicant believes the pending application is in condition for allowance.

Dated: October 19, 2006

Respectfully submitted,

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[REPLACEMENT SHEET]

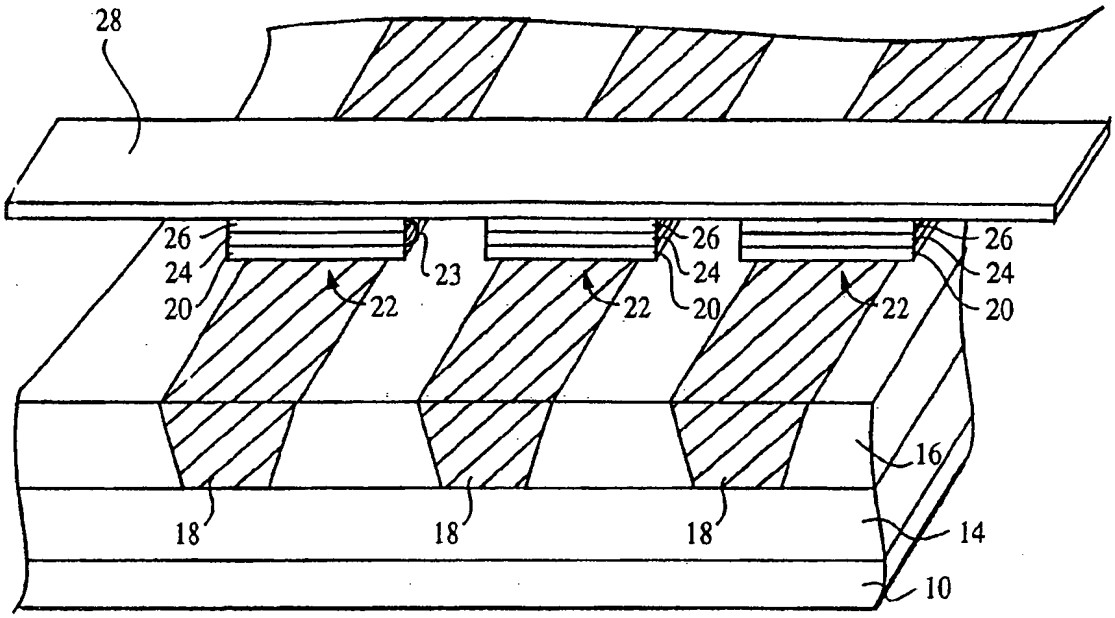

FIG. 1
(PRIOR ART)